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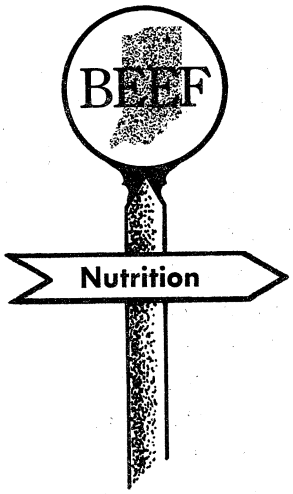

Vitamins for Beef Cattle and Sheep

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Vitamins are organic chemical compounds which are nutritionally essential, but are required in very small amounts. Vitamins occur naturally in plant and animal products. However, there is a wide variation in the amount of each vitamin contained in different feeds. Vitamin activity of forages and grains may be reduced by weathering, handling, heating, or harvesting at advanced stages of maturity.

Vitamins A, D, E, and K are called "fat-soluble" vitamins because they are soluble and carried in fats. The B-complex and vitamin C are "water-soluble" and are soluble in water but not fats.

Different vitamins show deficiencies in different ways. Visual deficiency symptoms associated with different vitamins are not frequently found under farm situations. In practical feeding situations a lack of certain vitamins can result in reduced weight gains and feed efficiency, lowered resistance to disease, and lowered fertility in breeding stock before visual deficiency symptoms appear.

This publication presents some of the current facts on vitamin deficiencies, requirements, and supplementation for beef cattle and sheep. Although vitamins A, D, and E receive first consideration in beef cattle and sheep, all vitamins will be discussed.

Vitamin A

One of the chief functions of vitamin A is to maintain health of the soft, moist tissues; such as the mucous membranes of the respiratory system. Consequently, vitamin A helps prevent many respiratory illnesses such as pneumonia.

Deficiencies - Loss of appetite, rough haircoat, lowered weight gain and reduced feed efficiency are the deficiency symptoms that appear first and are most important in farm situations. More advanced symptoms are night blindness (inability to see well in poor light), swelling of legs and brisket, poor muscular coordination, watery eyes, infertility, abortions and weak or dead calves or lambs. A common deficiency symptom in breeding herds and flocks is lowered fertility and calving or lambing percent.

Vitamin A storage - Relatively large amounts of vitamin A can be stored in the liver and other tissues of beef cattle and sheep when they receive a surplus in their rations. The length of time required for an animal to suffer deficiency symptoms depends on the quantity stored in the body. Since younger animals have a greater requirement in proportion to their weight, calves and lambs may show deficiencies in one to two months if a ration does not contain the required amount for the animal. Yearlings and mature animals

are usually capable of storing enough vitamin A to last two to five months. Deficiencies are most likely to occur during late winter when body stores have been depleted; especially after a season of poor pasture or where poor quality forages are fed.

Vitamin A activity - Vitamin A does not exist in forages or grains, as such, but as a precursor of the vitamin known as Beta-carotene. There are other types of carotene in feeds but Beta-carotene is the main source of vitamin A. Vitamin A activity of a feed indicates the total vitamin A content, whether furnished by carotene or some other source. Vitamin A activity is usually expressed in International Units (I.U.).

Ruminants generally can convert carotene to vitamin A and, therefore, the requirements may be met if enough carotene is present in the feed and if the animal properly converts carotene. Carotene has no known use in the body except to provide a source of vitamin A and, therefore, is of no value unless converted to vitamin A. Table 1 gives the percent dry matter and carotene content of feeds commonly fed to beef cattle and sheep.

Table 1. Dry Matter, Beta-carotene and Vitamin A activity of common beef and sheep feeds 1/

	Dry Matter %	Beta-carotene mg/lb.	Vitamin A Activity I.U./lb. 2/
Dry Roughages			
Alfalfa, early bloom	90	51.9	20,760
Alfalfa, mid-bloom	90	13.6	5,440
Alfalfa, weathered	90	2.0	800
Orchardgrass, mid-bloom	88	13.4	5,360
Corncobs	93	--	--
Corn fodder	82	--	--
Silages			
Alfalfa, wilted	36	8.5	3,400
Alfalfa, not wilted	30	12.4	4,960
Sorghum	29	4.4	1,760
Corn, dent, dough stage	29	4.4	1,760
Concentrates			
Corn, No. 2	89	0.8	320
Ground ear corn	73	0.7	280
Dehydrated alfalfa leaf meal (20% protein)	92	98.2	39,280
Dehydrated alfalfa meal (17% protein)	92	73.0	29,200
Linseed meal, solvent	91	--	--
Oats	89	--	--
Soybean meal	89	--	--

1/ Feed analyses taken primarily from Nutrient Requirements of Beef Cattle, Publication 1137, National Research Council, National Academy of Sciences, 1963.

2/ The Vitamin A activities assume that the animal converts 1 milligram of Beta-carotene to 400 I.U. of Vitamin A.

Beef cattle can usually convert 1 milligram of Beta carotene to 400 I.U. of Vitamin A. The conversion rate for sheep is between 400 and 550 I.U. per milligram of Beta-carotene. Table 1 was prepared assuming that 1 milligram of Beta-carotene equals 400 I.U. of Vitamin A. The Beta-carotene contents of dehydrated alfalfa meals are presented assuming a guaranteed minimum analysis of 60 grams of Beta-carotene per pound.

The Vitamin A activity values from Table 1 should be regarded as maximum amounts. Carotene in feeds can be destroyed through exposure to air, storage, weather, or heat. Large losses occur in normal cutting and curing of hay. Any type of processing destroys some carotene in the green crop. Leaves on most plants are much higher in Vitamin A activity than stems. Leafy, properly field-cured or dehydrated hay will be high in activity, but weathered and stemmy hay will be very low in activity. Making silages or haylages preserves a high percent of the original carotene.

Many factors concerning the animal and its ration may influence how efficiently carotene is converted to Vitamin A: (a) stress conditions: Heat, exercise (b) individuality and past history of the animal (c) type of ration and level of feeding (d) content of nitrates in the ration (e) content of Vitamin E in the ration (f) unknown ration factors.

Vitamin A requirements - Each type of animal must receive a certain amount of carotene or Vitamin A in the ration or by means of injection. Tables 2-3 give the daily Vitamin A requirements for different classifications of beef cattle and sheep.

The requirements in Tables 2 and 3 should be considered as the minimum amounts needed for the respective animal classifications.

It is apparent from the Vitamin A activity of the feeds in Table 1 and the requirements in Tables 2 and 3 that sufficient Vitamin A may be available from common feeds in many feeding programs. However, because of some of the previously mentioned factors that may interfere with carotene conversion, and the large differences that can exist in carotene content of feeds, the feeder or

Table 2. Daily Vitamin A requirements for beef cattle 1/

Type of cattle	Body wt. lb.	Daily Vitamin A requirement I.U.
Finished as short yearlings	400	8,850
	600	12,300
	800	14,600
	1,000	17,300
Finished as yearlings	600	13,100
	800	16,700
	1,100	19,400
Normal growing heifers and steers	400	9,200
	600	12,300
	800	14,300
	1,000	15,800
Wintering pregnant heifers	700	20,000
	900 to 1,000	18,000
Wintering mature pregnant cows	1,000 to 1,200	18,000
Cows nursing calves - 3 to 4 mo. post-partum	900 to 1,100	42,000
Bulls - growth and maintenance	1,600	37,700

1/ Nutrient Requirements of Beef Cattle, Publication 1137, 1963, and Nutrient Requirements of Sheep, Publication 1193, 1964. National Research Council, National Academy of Sciences.

Table 3. Daily Vitamin A requirements for sheep 1/

Type of Sheep	Body wt. lb.	Daily Vitamin A requirement I.U.
Lambs - fattening	60	550
	80	770
	100	935
Replacement Ewes and rams - lambs and yearlings	60	765
	80	1,035
	100	1,260
	120	1,530
	160	2,025
Ewes non-lactating first 15 wk. of gestation	100	935
	140	1,320
	160	1,485
Ewes - last 6 wk. gestation and nursing lambs	100	2,320
	140	3,160
	160	3,640

1/ Nutrient Requirements of Beef Cattle, Publication 1137, 1963, and Nutrient Requirements of Sheep, Publication 1193, 1964. National Research Council, National Academy of Sciences.

breeder cannot afford to overlook Vitamin A supplementation if there is any chance of a borderline deficiency. This is especially true since synthetic commercial sources of Vitamin A are quite inexpensive.

New feeder cattle and sheep - Feeder cattle or sheep that are being started on feed usually have lower incidence and severity of health problems if their Vitamin A intake is kept high for the first 3 weeks. Supplementing new cattle at the rate of 50,000 I.U. per head daily for the first three weeks gives good results.

Supplementing lambs at the rate of 3,000 to 4,000 I.U. per head daily for 3 weeks should be satisfactory.

Intramuscular injectable Vitamin A also has a definite place with new cattle and lambs; especially when they are from drought areas, have a history of Vitamin A deficiencies, or are exposed to rations low in carotene. Injection of calves with 1 million I.U. or more and lambs with 100,000 I.U. or more provides readily available protection for at least the first month. Many cattle feeders routinely inject new cattle with Vitamin A on arrival.

Cattle and sheep on pasture - Most pastures contain ample carotene during the spring and early summer months. Therefore, usually there is no need for supplementing grazing animals during this period. Pastures that are not over-grazed during late summer, and early fall should also furnish sufficient carotene. Cattle or sheep on short, dry pastures need additional vitamin A, protein and energy to maintain weight gains and production. If good quality hay is used, the Vitamin A requirements may be satisfied; if a grain supplement is used, synthetic Vitamin A should be added to the concentrate.

Feedlot cattle and sheep - Research trials conducted with feedlot animals have often shown increased weight gain and feed efficiency when supplemented with Vitamin A even though the forages and grains should have furnished sufficient carotene. Hot weather also tends to increase the need for additional Vitamin A. Some general recommendations concerning the level of supplemental A on different rations are presented in Table 4.

When the feeder is in doubt about the Vitamin A status of his animals, he should provide additional Vitamin A supplements.

Pregnant and nursing cows and ewes - The Vitamin A requirement for cows suckling

Table 4. Levels of supplemental Vitamin A for 700-pound feeder cattle and 70-pound feeder sheep fed different rations

Basic Ration	Supplemental Vitamin A (I.U./head daily [1/])	
	Beef	Sheep
Full-fed good-quality hay; limited corn	10,000	None
Full-fed poor-quality hay; limited corn	20,000	800
High corn silage; no hay; limited corn	20,000	800
Limited good quality hay, full-feed corn grain	20,000	800
Full-feed grass silage or haylage; limited grain	None	None
Past history of Vitamin A deficiency in the animals or on the farm	40,000	1,600

calves or ewes suckling lambs are much greater than for pregnant, non-nursing animals. For example, a 1,000-pound mature pregnant cow not suckling a calf requires 18,000 I.U. per head daily; but a cow of the same size 3 to 4 months after calving needs 42,000 I.U. If the dam does not have sufficient Vitamin A or carotene in the ration, milk production will be reduced and the young animal may not grow properly.

Injectable Vitamin A is also useful in situations where the silages and hays meet the lactating animal's needs for protein but have doubtful Vitamin A activity. In these situations, concentrates may not be needed. Injecting pregnant cows with 3 to 5 million I.U. and ewes with 500,000 I.U. about 2 months before calving or lambing will provide protection against possible deficiencies.

Vitamin D

Vitamin D is essential for proper utilization of calcium and phosphorus in developing strong teeth and bones. Although Vitamin D is needed by all animals, greater amounts are needed by young, growing animals than mature animals. A Vitamin D deficiency results in rickets, which is characterized by poorly developed bones, swollen joints, bent knees, stiffness, weakness, arched backs, and poor appetites.

Green plants contain ergosterol, a compound that can be changed to Vitamin D by sunlight after the plant is harvested and allowed to dry in the sun. Another source of Vitamin D for animals is a special type of cholesterol which is found in the skin. Sunshine can convert this material to Vitamin D which is then absorbed into the body.

Sun- or field-cured alfalfa hay contains about 900 I.U. of Vitamin D per pound compared to 215 I.U. per pound of barn-dried alfalfa hay. Grass hays generally contain less than legumes. Wilted alfalfa silage contains about 131 I.U. per pound; whereas, direct-cut silages and grains contain little or no Vitamin D. Corn silage contains about 54 I.U. per pound.

Requirements of Vitamin D per 100 pounds of body weight are approximately 300 I.U. for cattle and 250 I.U. for sheep.

Animals exposed to 30 to 45 minutes of sunlight per day or which receive even a small amount of sun-cured hay (cattle 3 to 4 pounds and sheep 1 pound daily) should have their Vitamin D requirements satisfied.

If animals are confined for long periods without sunlight or sun-cured feeds, a supplemental source of Vitamin D such as irradiated yeast or other prepared supplements should be provided.

Vitamin E

In general, this vitamin has not been a feedlot problem for cattle or lamb feeders. However, a relationship has been found in some research studies between Vitamin A utilization and ration content of Vitamin E. There is also research being conducted on the effects of injectable and oral Vitamin E on feedlot gains, efficiency and health. Injecting new feeder cattle with "E" may reduce incidence and severity of health problems during the initial feedlot period.

One of the best known deficiency symptoms is a degeneration of certain muscles, called "stiff lamb disease" in young lambs and "white muscle disease" in calves. These diseases, characterized by paralysis varying from a slight lameness to a complete inability to stand and resembling muscular dystrophy, have been prevented or cured by using Vitamin E.

Selenium, a mineral required in very small amounts, is also involved with Vitamin E in the prevention of muscular dystrophy and in allowing normal growth and fertility. In Indiana, selenium deficiency is not usually a serious problem. In certain sections of the Western Range states, selenium toxicity frequently occurs.

Although little information is available on Vitamin E requirements for sheep, the requirements of young calves range from 20 to 80 I.U. per 100 pounds daily.

Whole grains and many other seed crops contain large quantities of Vitamin E, which is primarily in the oil of the seed. Green, leafy forages are also high in E. Wheat germ oil is especially rich in Vitamin E and may be used as a supplement. Rations commonly used in Indiana contain ample Vitamin E to meet requirements of cattle and sheep. If the producer experiences calf or lamb diseases resembling a Vitamin E deficiency, a veterinarian should be relied on to diagnose the condition. Lambs suffering from Vitamin E deficiency should be given 500 milligrams of alpha-tocopherol-acetate orally with a continuing dosage of 100 milligrams every second day, or deficient lambs may be treated with 300 milligrams of injectable alpha-tocopherol. There is no established dosage for calves, but an accepted dosage is approximately 1,000 milligrams of alpha-tocopherol-acetate orally every second day or an injectable product. In herds or flocks with a history of Vitamin E deficiency, the incidence of muscular dystrophy may be reduced by feeding cows 2 to 3 pounds of whole grain per head daily for the last 60 days of pregnancy and feeding ewes .5 pound of whole grain for the last 2 weeks of pregnancy.

Vitamin K

This vitamin is synthesized by ruminant animals in ample amounts and is also found abundantly in either fresh or dried green, leafy forages. Vitamin K is called the anti-hemorrhagic vitamin because it is necessary for the normal clotting of blood.

Vitamin K deficiencies may occur in cattle if moldy sweet clover, which contains a substance known as dicumarol, is fed. Dicumarol is antagonistic to Vitamin K and, when present, neutralized the effect of Vitamin K. Intake of dicumarol may result in generalized bleeding, therefore, requiring a Vitamin K supplement. However, such cases are rare and there is usually no need for supplemental Vitamin K.

B Complex Vitamins

The list of B vitamins includes thiamine, niacin, riboflavin, pantothenic acid, biotin, B^2, choline, pyridoxine, and folic acid. Normally, all of these are synthesized in sufficient amounts by rumen bacteria. Young calves and lambs, before the rumen is developed and functioning, need B vitamins. However, these B complex vitamins are supplied by whole milk. Green forages and good hay

or silage are sources of all B vitamins except B_{12}. Animal by-products are good sources of B_{12}. A sufficient amount of cobalt is necessary for rumen synthesis of vitamin B_{12} and may be a limiting factor in areas where cobalt deficiencies exist. In these cases, using supplemental cobalt will allow ample rumen synthesis.

Vitamin C

Research has suggested that dietary sources of Vitamin C are needed only by men, monkeys and guinea pigs. Ruminants do not need Vitamin C in their rations since it is synthesized by rumen bacteria. Vitamin C contained in feeds for ruminants is destroyed in the rumen by bacterial fermentation. Young calves and lambs with undeveloped rumens obtain sufficient Vitamin C from milk.

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